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ABSTRACT

This booklet was developed to provide Honolulu (Hawaii) students with an activity-oriented opportunity to learn more about water and water conservation. It contains inquiry-based games, puzzles, and activities dealing with: (1) how we use water; (2) where water comes from; (3) surface water; (4) groundwater; (5) population growth and its effect on water usage; (6) appliances that use water; (7) wasting water; (8) water saving tips; (9) the importance of water to the ancient Hawaiians and Egyptians; and (10) the Honolulu Board of Water Supply. The answers to questions proposed in some of the activities are provided in the back of the booklet. (TW)

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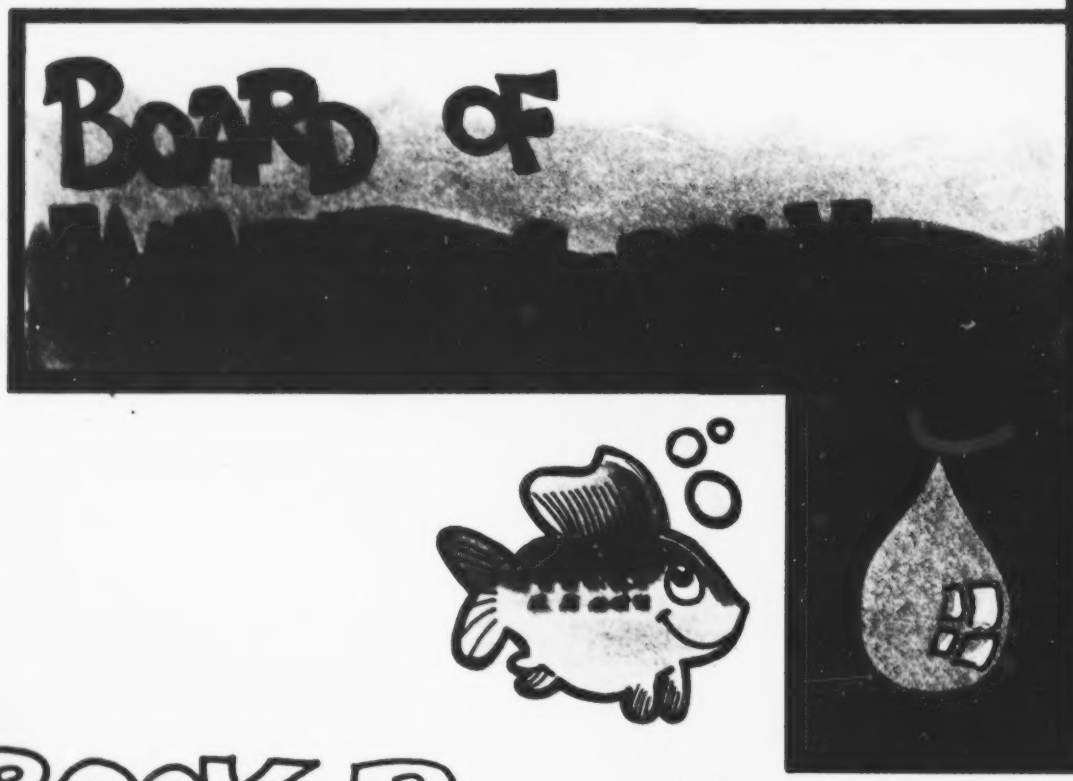
AN ACTIVITY BOOK

BY THE HONOLULU BOARD OF



SE 046 546

BOOK B

M	H	B
T	Y	P
L	D	C
Z	R	O
P	O	M
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N	I	E
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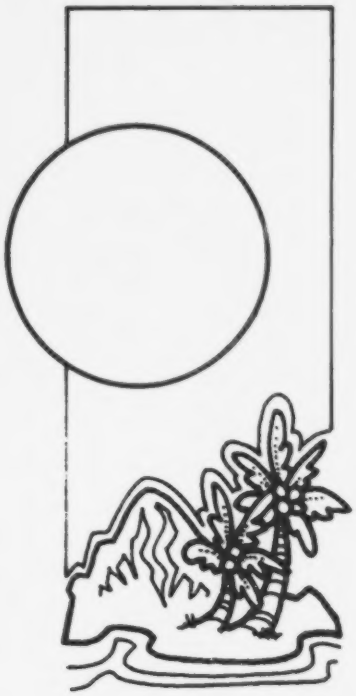

This book was created to provide Honolulu's students with an activity-oriented medium to learn more about water and water conservation.

Since August of 1979, thousands of students have visited the Fred Ohrt Water Museum in Kalihi where the Honolulu Board of Water Supply offers free tours. Other informational material distributed at the museum and available from the department include coloring books, comics, stickers and brochures.

Credits are due to **Donald L. Buchholz**, author and illustrator whose special talents created this publication especially for the Honolulu Board of Water Supply.

Board of Water Supply

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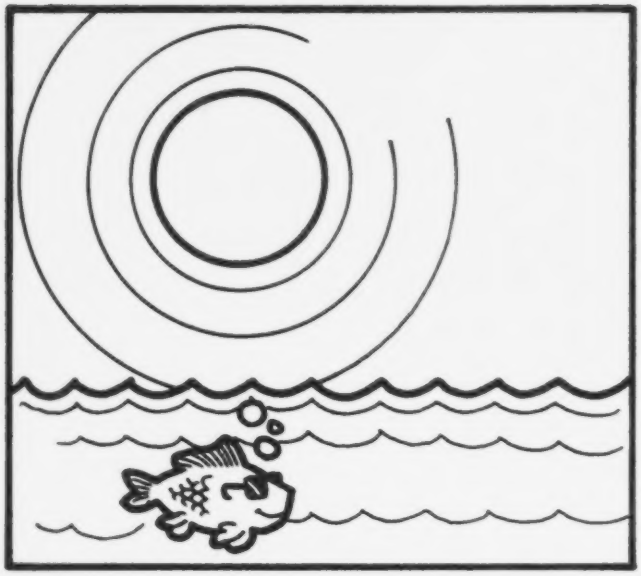
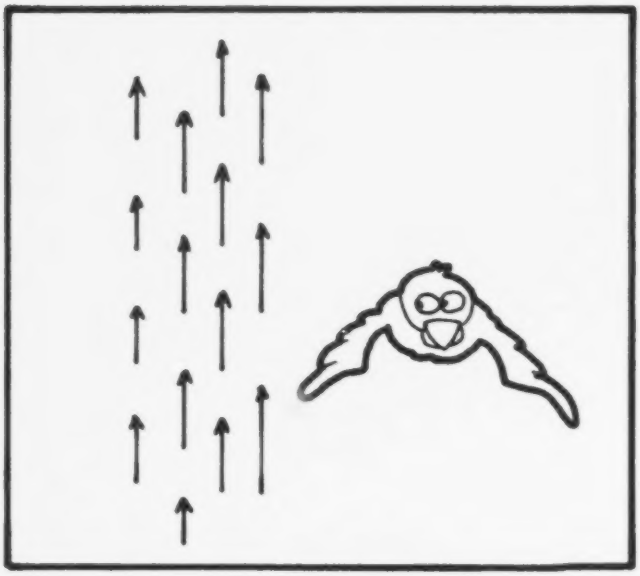
Where Does Water Come From?

What are you doing now?
Looking for water.
Looking for water? Up there? Water is in streams and rivers — in the faucets in the kitchen and in the bathroom and in the garden hose!
So what are you looking up there for?

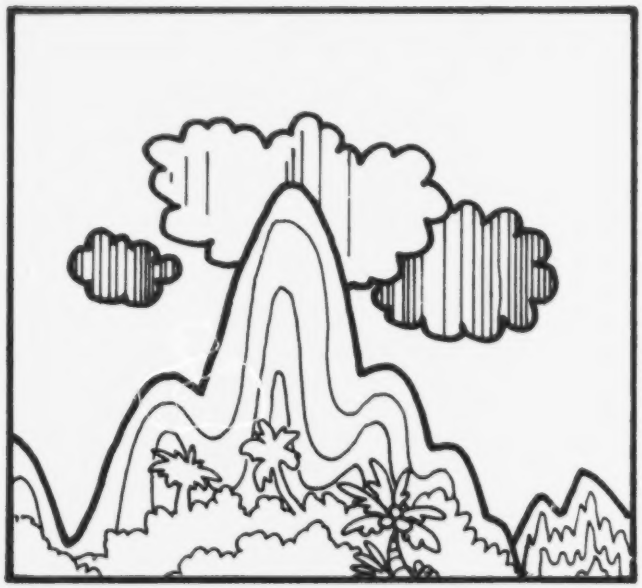
Our water comes from rain.
Let's start at the beginning:



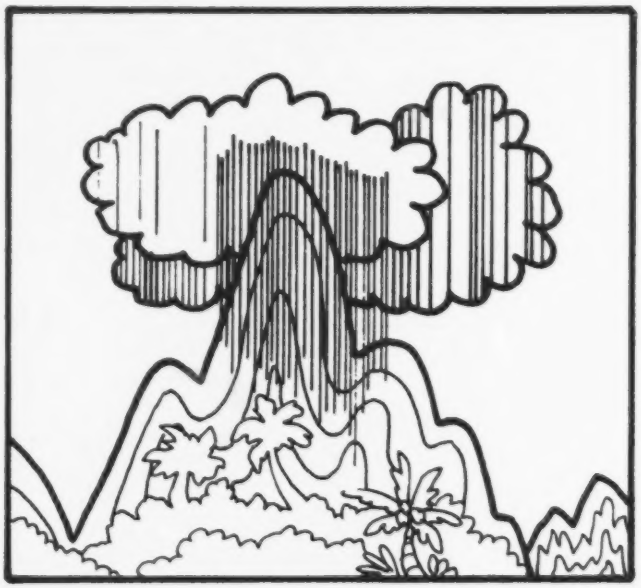
The sun shines on the ocean.



Soon water heats up and **EVAPORATES** (it turns into steam, or water vapor) and rises.



Clouds of this water vapor get together up where the air is cool and the water vapor **CONDENSES** (it turns back into water).



and then... you guessed it:

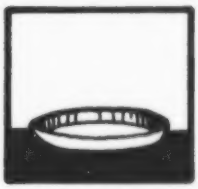
IT RAINS!

OBSERVING

1. Evaporation

Get two dishes of water from the faucet.

Put one dish in the sun



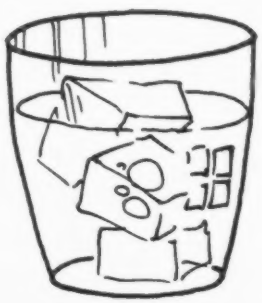
and the other in the shade.
Wait two hours.

What happens?

2. Condensation

Take a glass of ice water and set it on the table.

Wait a few minutes.



What happens?

runs off the mountain and heads back to the ocean. This water makes rivers and streams and is called surface run-off.

Did you know

that in ancient Hawaiian days it was **kapu** to bathe or wash clothes upstream– bathing and washing were only permitted at the mouth of the stream.

Do you know why?

Can you think of any **kapu** about water and using water that might be a good idea today?

The rain water that isn't surface run-off goes into the ground

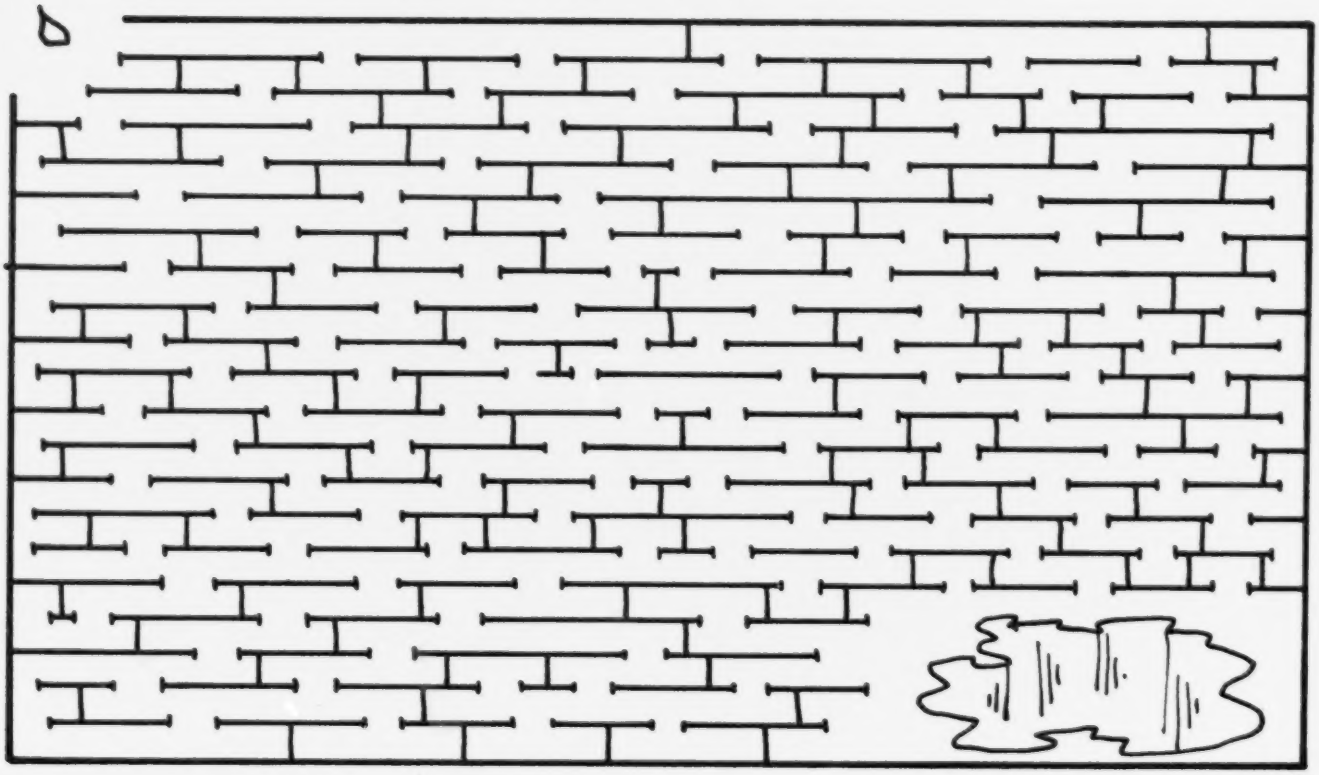
and runs through spaces and cracks in the **porous*** volcanic lava rock,

* porous means it has holes in it.

and sometimes ends up in underground, watertight pockets called **dike compartments.**

This underground water is our most important source of water.

Find a path for water to go through the mountain.



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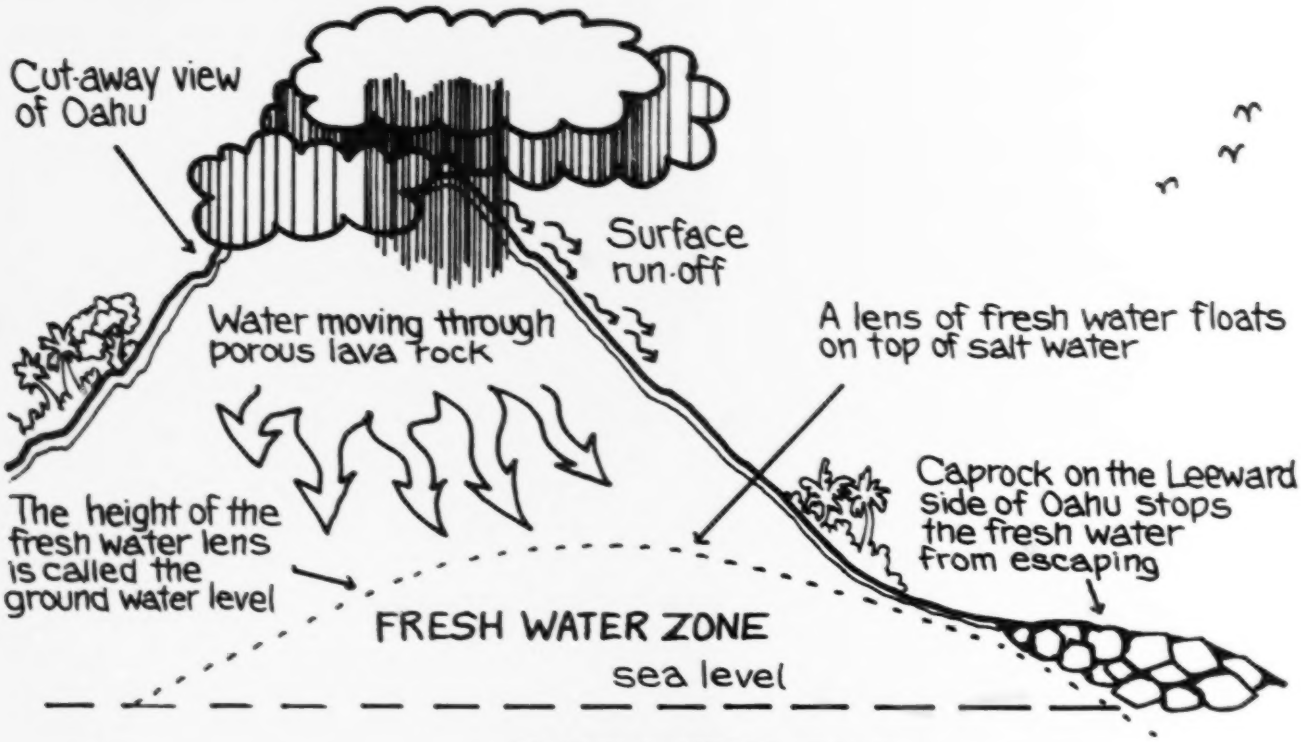
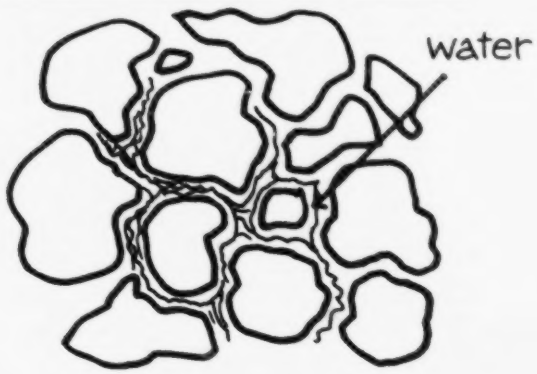
How ground water works


Cut-away view of Oahu
Surface run-off
Water moving through porous lava rock
A lens of fresh water floats on top of salt water
Caprock on the Leeward side of Oahu stops the fresh water from escaping
The height of the fresh water lens is called the ground water level
FRESH WATER ZONE
sea level
SALT WATER ZONE

Don't forget that lava rock is 10-30% porous – that's where the water is: in the cracks and holes in the lava rock and between the rocks.

The other 70-90 % of this area is **solid rock.**

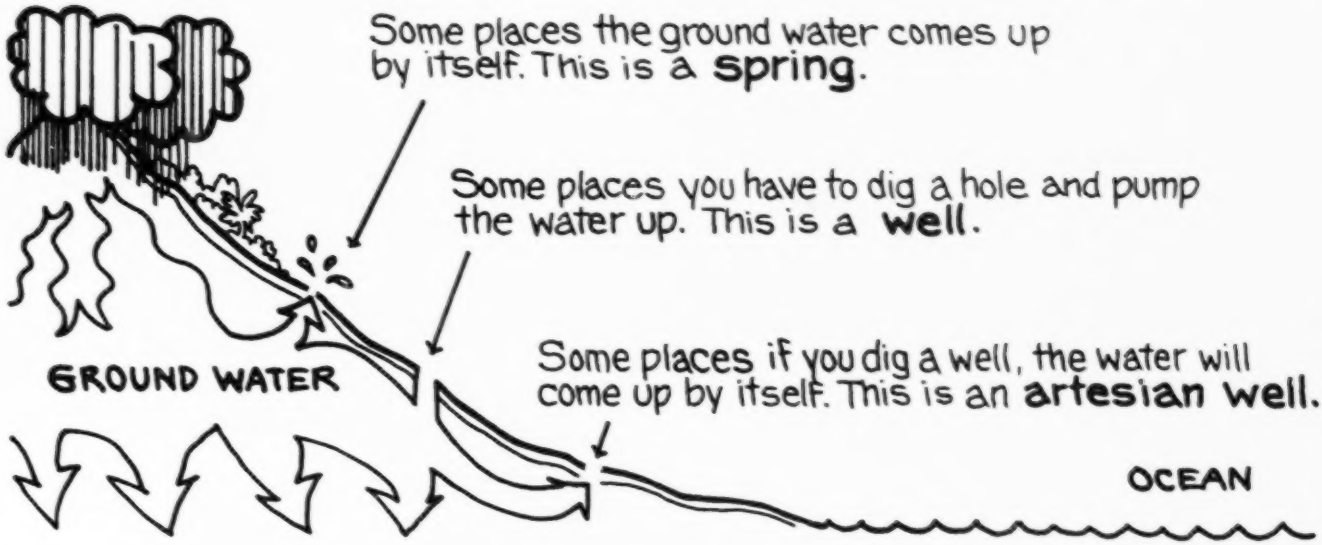


Did you know

that our water is so pure from being filtered through the lava rock that we don't need to add any chemicals or anything to make it taste good or make it safe.

It already is.

There are a number of ways to get at this underground water.

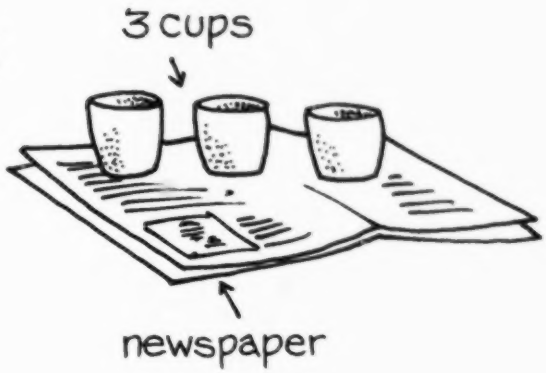

Some places the ground water comes up by itself. This is a **spring**.
Some places you have to dig a hole and pump the water up. This is a **well**.
Some places if you dig a well, the water will come up by itself. This is an **artesian well**.
GROUND WATER
OCEAN

OBSERVING

Get 3 paper or styrofoam cups. Poke 4 small holes in the bottom of each cup with a pencil.

Fill each cup half full using

stones	sand	dirt
cup 1	cup 2	cup 3



Carefully fill the cups with water. Observe what happens. Which took the shortest time for the water to leak out? Which took the longest time?

A WATER CROSSWORD PUZZLE

Across

1. A glass of ice water will get wet on the outside as it stands. This is because of _____.

3. We have a lot of ground water here on Oahu because lava is _____.

5. Our water supply comes from _____.

7. _____ creates rivers and streams.

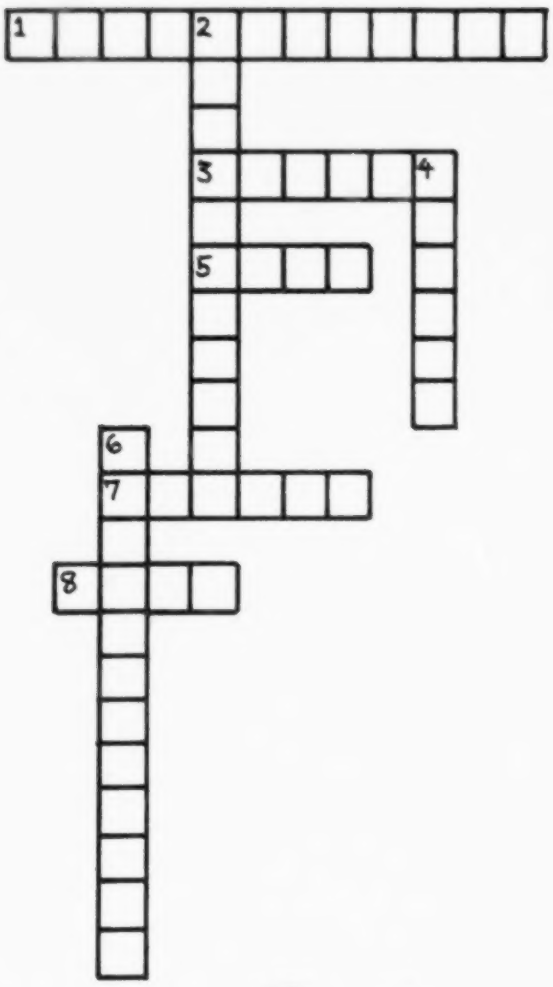
8. If you have to dig a hole and pump water out of the ground, this is called a _____.

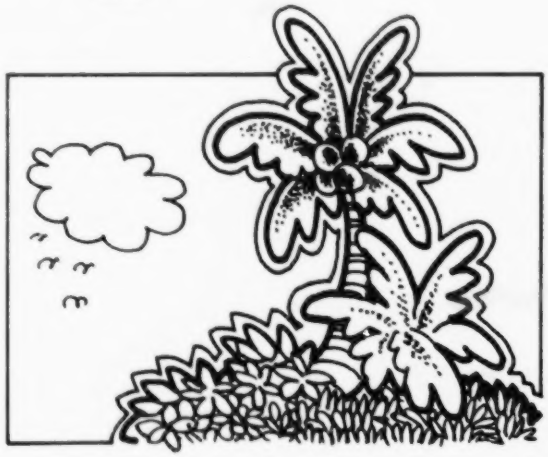
Down

2. If you put a dish of water outside in the sun, the water will soon disappear. This is called _____.

4. When ground water comes to the surface by itself, this is called a _____.

6. If you dig a well and the water comes up without the need of a pump, that is called an _____.





The ancient Hawaiians

considered fresh water (**wai**)
to be of great importance –
water was life itself.

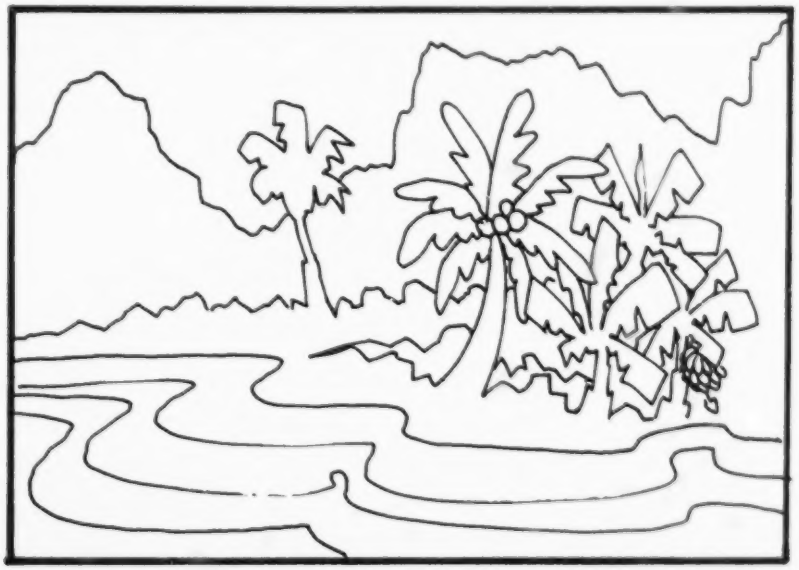
We can see how the early Hawaiians felt about water by looking at some Hawaiian words:

wai · fresh water

wai·wai · wealthy, or fulfilled (do you know the song **Kanaka Waiwai**?)

kanawai · laws (**kana** · belonging to or equally sharing + **wai** · fresh water)

Westerners talk about the law of the land;
Hawaiians talk of the law of the water.



The early Hawaiians got their drinking water from rivers, streams and springs.

Hawaiian Place Names

If you look at a map of Oahu – and other islands in the Hawaiian group, you will see a lot of place names that have the word **wai** in it:

Wai·pahu- water + bursting - the Hawaiian name for a spring on the leeward side of Oahu which later became a plantation town.

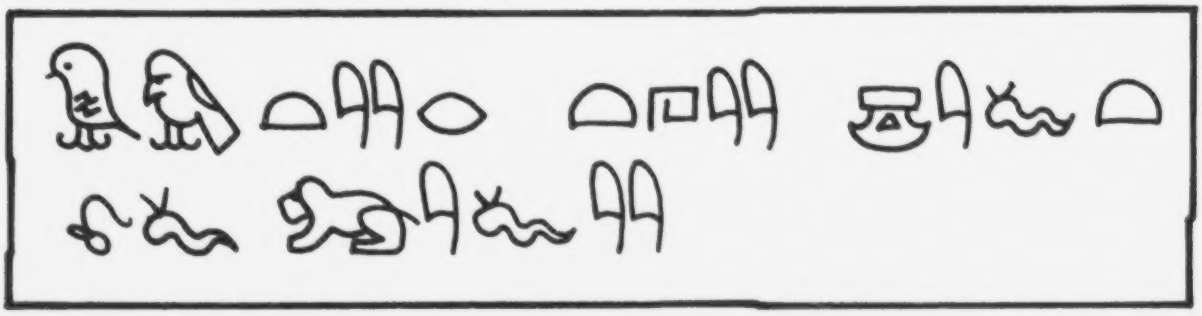
Dictionary Time

How many place names can you find that have **wai** as part of the name? What does the other part of the word mean? Can you tell why that place got its name?

Place name	Meaning

The Egyptians,

like the early Hawaiians, knew the importance of water – read their message below:



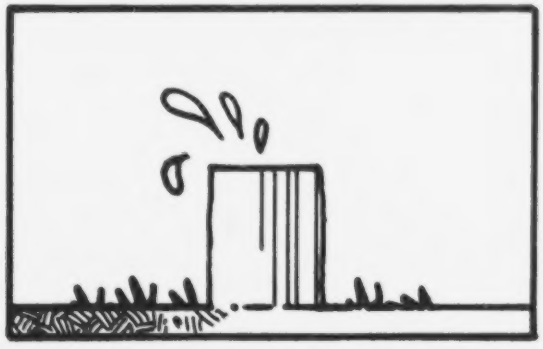
The Egyptians also had an alphabet. Use their alphabet to read their message.

Write messages to your friends

When there weren't very many people in Honolulu, the traditional Hawaiian water sources – streams, rivers and springs – were enough for everybody.

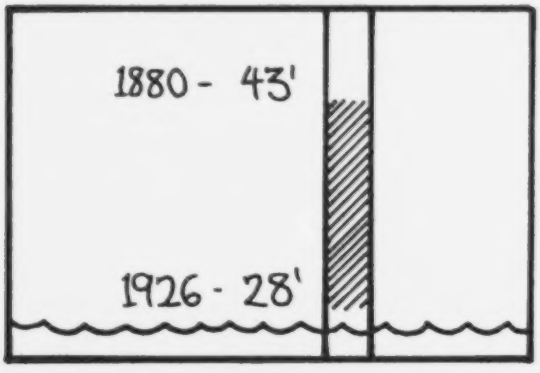
But as Honolulu grew in population, so did the need for water. Surface water began to dry up... but there was all that ground water – and only a small amount of it emerging in natural springs...

so in 1879 James Campbell dug an artesian well.



This was such a good idea that by 1910 there were 410 wells on Oahu!

And the wells worked so good that the ground water level dropped by 1/3.



Does this mean that the more water used – the less we have?

Read on

Unscramble the words to fill in the blanks.

Our _____ supply depends on _____.
wrate nair

_____ _____ about _____ _____ _____
yerev yad wot nillibo nallogs

of _____ falls in the mountains of Oahu.
nari

About 650 million _____ of this _____
llanogs arni

ends up _____.
dugerdrounn

When it doesn't _____ for a _____ _____,
anir nolg mite

this is called a _____.
throdug

It is during _____ that we
gurthods

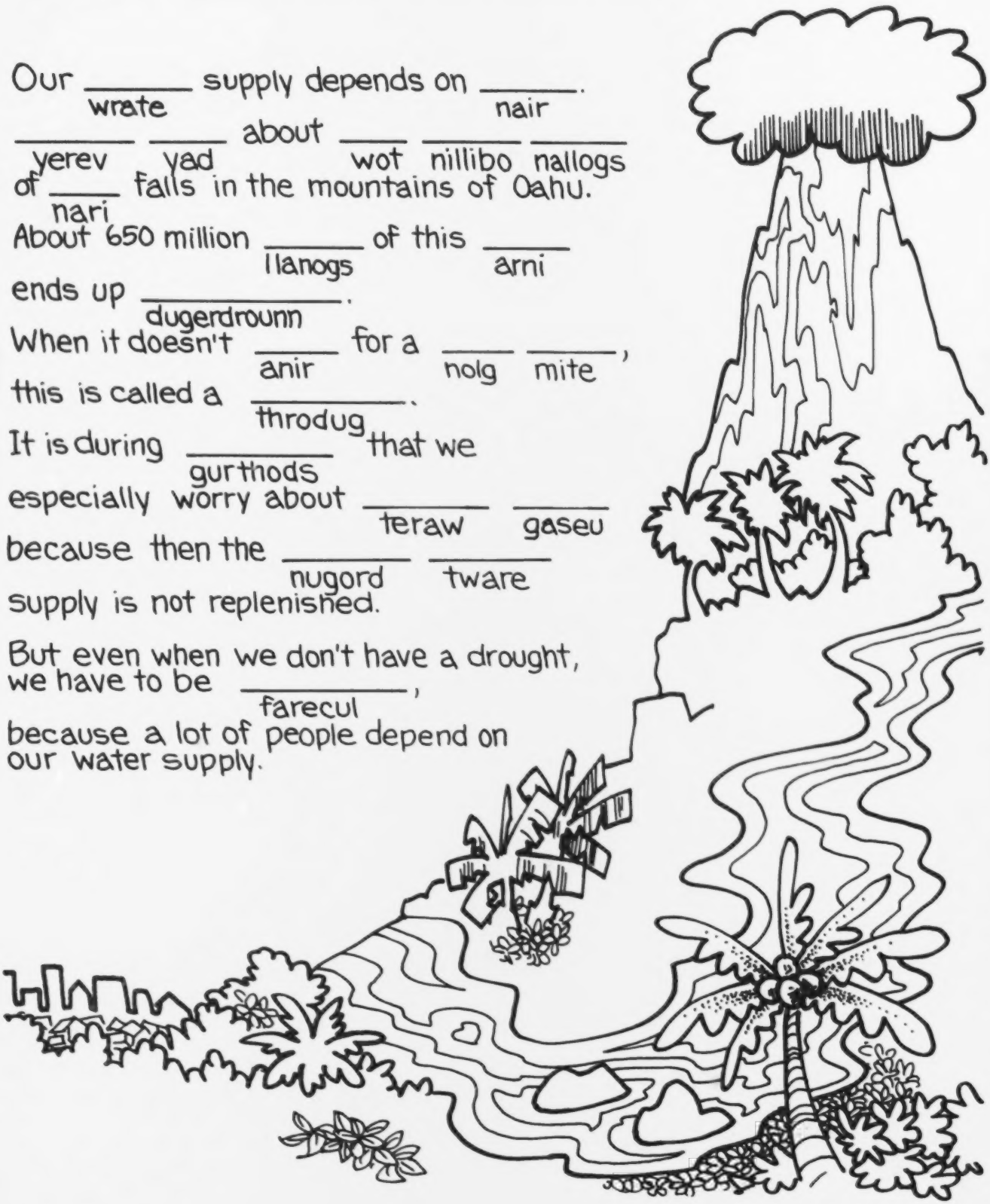
especially worry about _____ _____
teraw gaseu

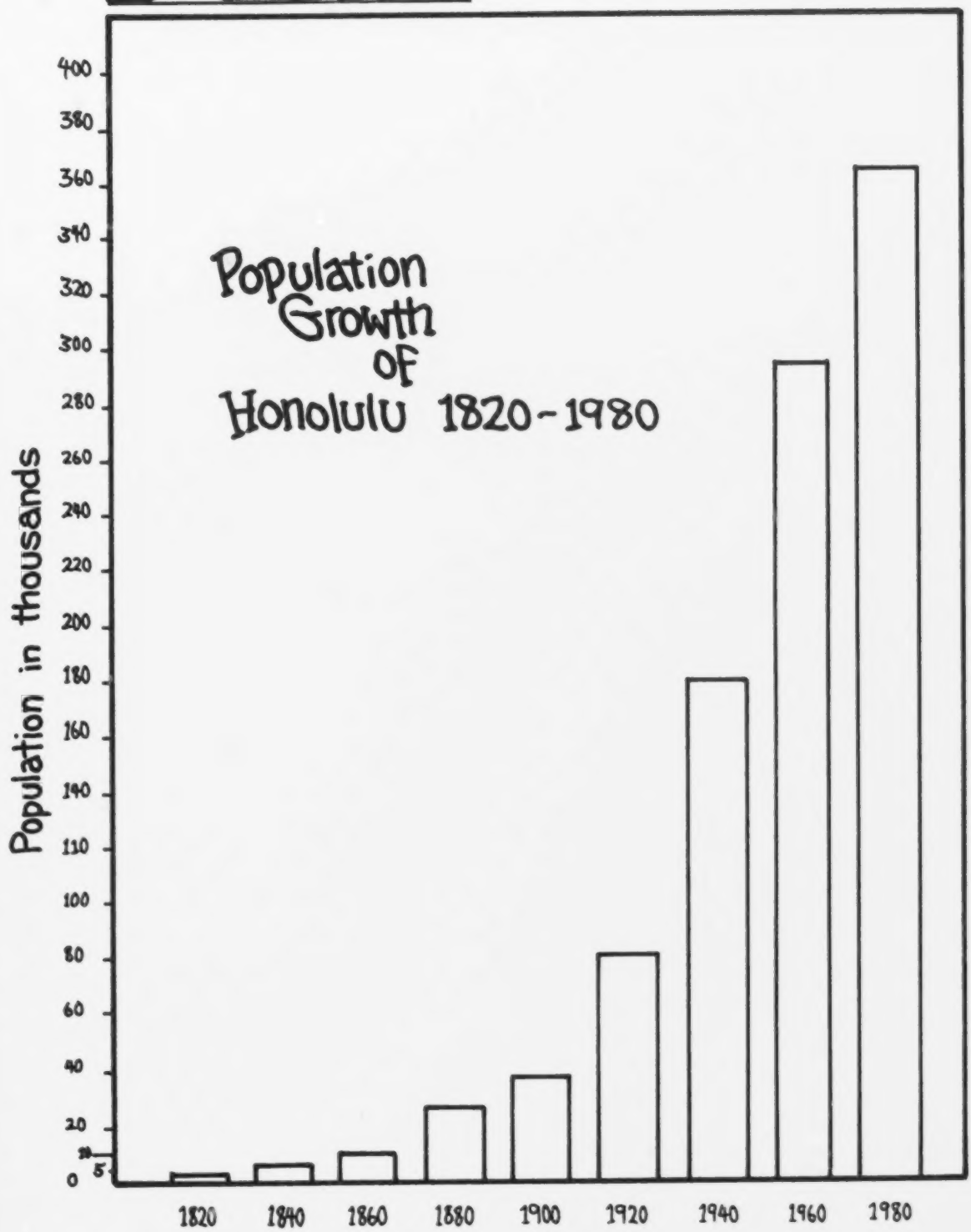
because then the _____ _____
nugord tware

supply is not replenished.

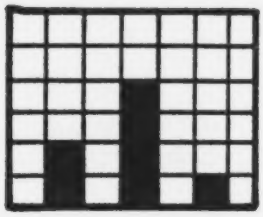
But even when we don't have a drought,
we have to be _____,
farecul

because a lot of people depend on
our water supply.




Population Growth of Honolulu 1820-1980
Population in thousands
400
380
360
340
320
300
280
260
240
220
200
180
160
140
110
100
80
60
40
20
10
5
0
1820
1840
1860
1880
1900
1920
1940
1960
1980

14



Graph Reading Practice

1. When was population growth the largest?
   a. 1920 - 1940 c. 1900 - 1920
   b. 1840 - 1880 d. 1940 - 1960 _____

2. When did the population become more than 20,000? _____

3. When Honolulu had a drought in the 1920s, how many people lived here? _____

4. More people needed water in 1880 than in
   a. 1940 c. 1960
   b. 1900 d. 1860 _____

5. Less people needed water in 1940 than in
   a. 1960 c. 1880
   b. 1920 d. 1820 _____

6. How many people in Honolulu depended on clean, good-tasting, safe water in 1960? _____

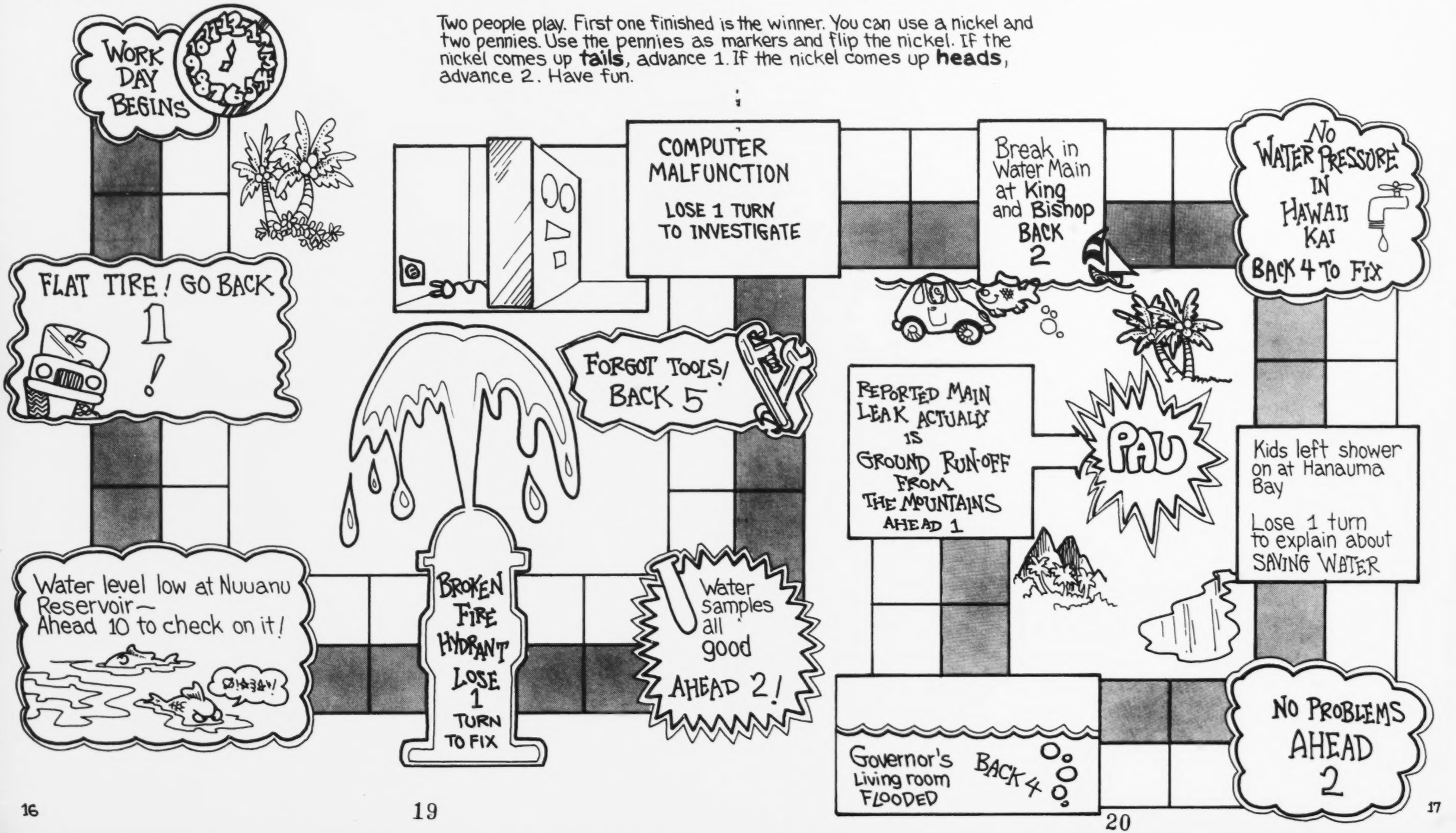
7. How many people in Honolulu needed water in 1900? _____

8. How many people in Honolulu depend on water to be clean, safe, good-tasting and readily available in 1980? _____

9. How many people lived in Honolulu in 1820?
   a. less than 1000
   b. less than 500
   c. less than 100
   d. less than 5000 _____

ALL IN A DAY'S WORK AT THE BOARD OF WATER SUPPLY

Two people play. First one finished is the winner. You can use a nickel and two pennies. Use the pennies as markers and flip the nickel. If the nickel comes up **tails**, advance 1. If the nickel comes up **heads**, advance 2. Have fun.


WORK DAY BEGINS
FLAT TIRE! GO BACK 1
COMPUTER MALFUNCTION
LOSE 1 TURN TO INVESTIGATE
FORGOT TOOLS! BACK 5
Break in Water Main at King and Bishop BACK 2
No WATER PRESSURE IN HAWAII KAI BACK 4 TO FIX
REPORTED MAIN LEAK ACTUALLY IS GROUND RUN-OFF FROM THE MOUNTAINS AHEAD 1
PAU
Kids left shower on at Hanauma Bay
Lose 1 turn to explain about SAVING WATER
Water level low at Nuuanu Reservoir— Ahead 10 to check on it!
BROKEN FIRE HYDRANT LOSE 1 TURN TO FIX
Water samples all good AHEAD 2!
Governor's Living room FLOODED BACK 4
NO PROBLEMS AHEAD 2

The Board of Water Supply

After the big drought in the 1920s, people began to worry about water. So, the **Board of Water Supply** was formed in 1929.

It is the responsibility of the **Board of Water Supply** to keep people supplied with water.

The **Board of Water Supply** tests water every day to make sure it is safe and clean. They also fix breaks in lines, do construction and maintenance work and look for new ways to bring more water up from the underground water system.

More than 600 people work for the **Board of Water Supply**. There are always people working – they watch water levels in the reservoirs and make sure that everything is working properly.

There is an **Emergency Number** to call anytime if there is a water emergency. Do you know where to find that number? Do you know your **Emergency Numbers** for the **Police**? The **Fire Department**?

The number to call for the Police, Fire Department and Ambulance is

The emergency numbers for the Board of Water Supply are

People who help to get your water to you have many kinds of jobs.

Making Job Words

A lot of our words come from other languages (from Chinese: ketchup; from Arabic: algebra... there are plenty).
Here are some Greek words to help you understand the meaning of some job words:

hydro·	water
geo·	earth
meteor·	weather
-ology	study of
-ologist	someone who studies

Now make some words

- The study of weather — meteor + elogy
- Someone who studies the weather — meteor + alogist
- The study of water — _____ + _____
- Someone who studies water — _____ + _____
- The study of the earth — _____ + _____
- Someone who studies the earth — _____ + _____

A lot of different people work in a lot of different jobs at the **Board of Water Supply**. How many jobs can you find in the puzzle that might be found at the **Board of Water Supply**?

C	O	M	P	U	T	E	R	P	R	O	G	R	A	M	M	E	R
C	H	E	M	I	S	T	U	O	W	I	S	E	E	E	N	N	C
U	Y	K	T	O	G	A	R	D	E	N	E	R	S	T	A	G	A
O	D	E	D	I	L	O	R	E	P	A	I	R	M	E	N	I	S
T	R	U	C	K	D	R	I	V	E	R	N	C	I	R	M	N	H
Z	O	C	B	K	L	D	S	E	C	R	E	T	A	R	Y	E	I
R	L	M	I	W	E	L	D	E	R	N	K	E	H	E	W	E	E
B	O	O	K	K	E	E	P	E	R	S	O	Y	T	A	H	R	R
E	G	E	O	L	O	G	I	S	T	C	A	A	C	D	N	S	S
E	I	P	I	P	E	F	I	T	T	E	R	S	L	E	U	E	I
R	S	M	E	C	H	A	N	I	C	S	D	O	E	R	O	N	M
C	T	I	N	V	E	S	T	I	G	A	T	O	R	S	H	M	M
A	S	A	C	C	O	U	N	T	A	N	T	S	T	T	T	Y	U
G	R	O	U	N	D	S	K	E	E	P	E	R	S	E	V	O	T

_____
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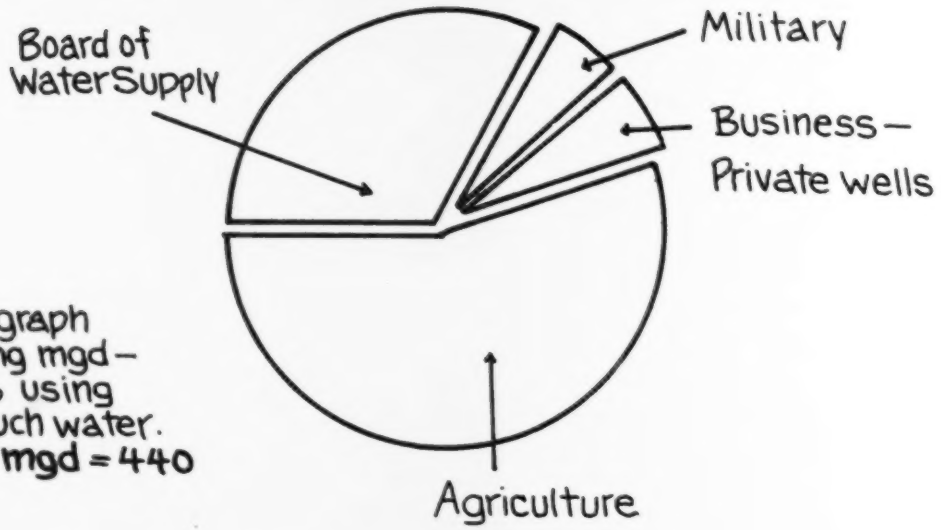
Millions of Gallons!!



A pie graph showing mgd – who is using how much water.
Total mgd = 440

Water use is talked about in millions of gallons per day, (mgd)

1. Who uses the most water?

_____

2. Who uses the least water?

_____

3. Agriculture uses 230 mgd. What percentage of total mgd is used by Agriculture?

a. 52% c. 03%
b. 25% d. 72%

_____

4. Military usage is 40 mgd. What percentage of total mgd is used by the Military?

_____

Water Mathematics

Fact: the average household in Honolulu today uses 440 gallons of water per day.

1. How much water does the average family use in a month? _____

2. Look at your family's latest water bill. It represents your family's water usage for **two months**. How much water did your family use in each month?

   per month A. _____ per day _____

   per month B. _____ per day _____

   What is your average monthly usage? _____

   What is your average daily usage? _____

3. Water charges are figured by the amount per 1000 gallons. Can you compute your cost? (monthly usage ÷ 1000 ÷ your **monthly** cost) _____

4. In 1929 the cost per 1000 gallons was 9¢. What do you think a water bill was per month in 1929? Did a family in 1929 use as much water as we do today?

   _____

   _____

   _____

   _____

5. What about a family in 1829? Explain. _____

   _____

   _____

Appliances and Gadgets in Daily Water Use

Find 10 things that use water in the puzzle below

S	T	E	R	E	O	E	A	R	P	H	S	N	R
I	S	U	R	F	B	O	A	R	D	A	P	R	A
D	I	S	H	W	A	S	H	E	R	W	R	Y	T
W	T	S	D	A	U	T	O	M	O	B	I	L	E
L	M	Y	M	T	O	I	L	E	T	U	N	O	R
I	R	I	C	E	C	O	O	K	E	R	K	L	B
K	N	L	I	R	A	L	L	B	E	R	L	E	E
O	M	G	S	H	O	W	E	R	Y	U	E	Y	D
C	O	F	F	E	E	M	A	K	E	R	R	U	L
S	O	C	W	A	S	H	M	A	C	H	I	N	E
U	K	L	S	T	E	A	M	I	R	O	N	U	D
C	C	E	I	E	W	A	T	E	R	B	E	D	M
H	O	F	I	R	E	H	Y	D	R	A	N	T	F

How many of these do you think were used in 1929?

_____

_____

_____

_____

_____

_____

How many of these do you think were used in 1829?

_____

_____

_____

_____

_____

_____

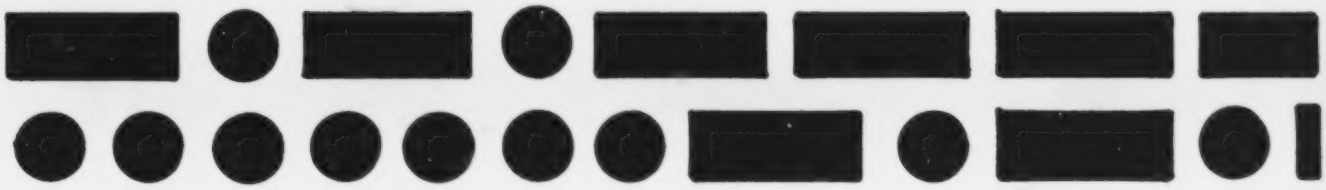
Looking For Leaks

Did you know that a dripping faucet could cost your family over $12 in a single water bill!

Look for leaks – faucets, showers, the bathtub, in the laundry room, the outside faucets...

Use this chart to help your family know about leaks and get them fixed.

Date	Location of leak	Date Fixed



Codes

sometimes use the alphabet, numbers, and different combinations. A simple code might just use the next letter in the alphabet

MJLF UIJT

A more difficult code might use a combination of both numbers and letters:

A is the first, you see,
B can make a _____
C can rhyme the number _____
... the rest is up to you.

Now solve the poem to get the clues — and read the code.

3 15 14 19 5 18 22 5

_ _ _ _ _ _ _ _

23 1 20 5 18

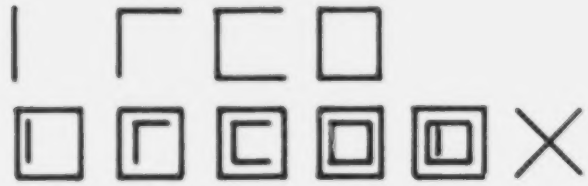
_ _ _ _ _

Make up your own codes using any combinations you can think of ... or use a different alphabet ... or ...

...or a code could use totally different symbols...

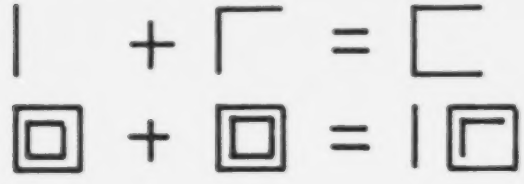
(don't let strange or new symbols bother you. Just figure them out.)

Look at the symbols in a different arrangement – like this:

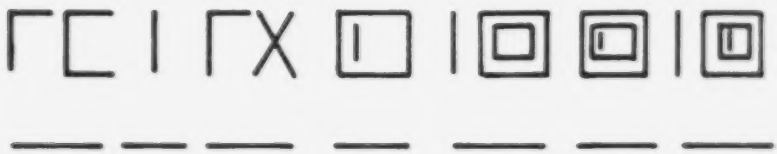


Notice anything? Right! The pattern repeats itself. Why would it do that?

One more clue:



Now, can you read this message? Don't forget how the code on page 24 worked – just do the same thing!



Conserving Water

There are a lot of ways you can help conserve water in your home every day.

Family Water Saving Tips

You can save up to 10 gallons of water if you turn off the water when you brush your teeth.

Take showers instead of tub baths, and shut off the water when you soap yourself – then turn it back on to rinse. You could save 20 gallons of water.

Keep drinking water in the refrigerator instead of running the faucet until the water is cold.

Use a stopper in the sink when you do the dishes instead of letting the water run – you could save up to 30 gallons of water per meal.

Use a broom or a rake to clean your sidewalks or driveway – you could save up to 50 gallons of water.

Use a bucket to wash the car – you could save up to 100 gallons of water every time you wash the car.

Wait until you have a full load of wash before you do the laundry – you could save up to 30 gallons of water.

Keep a record

of your efforts to save water. Write down your family's water usage total from your last water bill.

Date of use	Amount of water used	Total cost

Make a chart like this one to record your weekly efforts to save water. Make a small x every time you use one of the tips from page 26.

shut off faucet	
take shower	
use stopper/ dishwashing	
sweep sidewalks	
doing laundry	
other	

Keep your weekly records until the next bill comes – then check your family's water usage.

Date of use	Amount of water used	Total cost

Subtract the new totals from the old.

Amount of water saved	Money saved

27

Writing about water

Page 1 of this book is a cartoon strip about water; there is a Hawaiian legend about **Kane** and **Kanaloa** and water; a lot of stories, poems and even songs have been written about water.

You could write a poem using Japanese **Haiku** – an unrhymed verse form that has 5 syllables in the first line, 7 syllables in the second line and 5 syllables in the last line.

Water is our friend;
Without it we could not live.
Let's help conserve it!

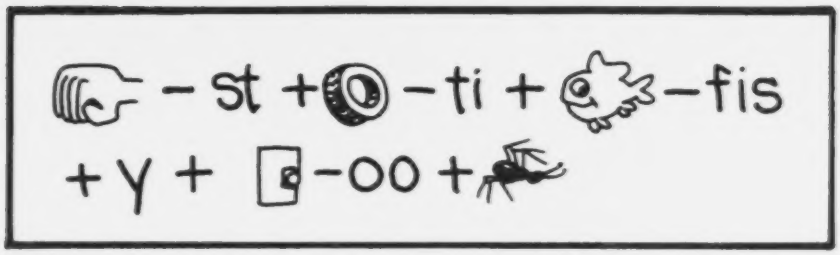
Or you could make a cartoon strip:

Or you could write your own story, poem or even song.

Making a Water Rebus

I'm short and squat
and could be used for a seat ;
I'm easy to spot
every 350 feet.

What am I?



A _____ _____

Make your own water-related rebus. Try it out with your friends. Can you solve theirs?

29

OBSERVING

How Water acts

Put a drop of water on

the back of your hand

a piece of folder paper

a piece of cloth

What happened? _____

_____

Can you tell why? _____

_____

How things act with water

Get 3 paper cups. Fill them with water.

In the first cup, put a drop of **cooking oil** _

In the second cup, put a drop of **milk** _

In the third cup, put a drop of **soy sauce** _

What happened? _____

_____

Can you tell why? _____

_____

_____

Get 3 paper cups. Fill them with water.

Put a spoonful of **sugar** in the first cup

Put a spoonful of **flour** in the second cup

Put a small amount of **pepper** in the third cup

What happened? _____

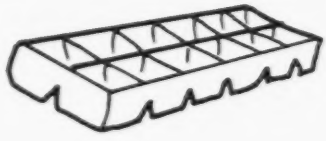
_____

Can you tell why? _____

_____

_____

A Recipe For A Taste Treat



Get an ice tray.

Fill it **half full** with orange juice. Cover the ice tray with aluminum foil and stick a toothpick in each square.

The next day, carefully remove the aluminum foil so you don't break or loosen the toothpicks.

Fill up the ice tray the rest of the way with grape juice. Refreeze.

Enjoy the treats with your friends!

Even though

there are more people on Oahu than ever before, we have the water we need--this is because of **The Board of Water Supply.** They maintain our water system and constantly look for new sources of water.

To help **The Board of Water Supply** find some new sources of water, use a mirror and take out the extra letter.

CLEFAFNUFPWAFSTFEFWATFEFR

_____

DEFSAFLIFNAFTEFOFCEFAFFNWAFTFERF

_____

And in the future we can be assured of a continuing supply of water if we just remember

DOFNOFTWAFSFTEFWAFFTEFRF

_____

Answers

p.4. to keep the rivers and streams clean.

p.8 ACROSS – 1.condensation, 3.porous, 5.rain, 7.run-off. 8. well
DOWN – 2.evaporation, 4. spring, 6.artesian well.

11. Water- the gift of life.

13. water, rain, every day, two billion gallons, rain, gallons, rain, underground. rain, long time, drought. droughts, water usage, ground water. careful.

15. 1.d, 2. 1880, 3. 80,000
4.d, 5. a, 6. almost 300,000
7. almost 40,000
8. about 365,000
9. d.

18. 911
7 a.m. – 3:30 p.m. - 527-6137
3:30 p.m. – 7 a.m. - 527-5200

19. hydrology, hydrologist
geology, geologist

computer programmer
chemist · gardener
repairmen · truck driver
secretary · welder
bookkeeper · geologist
investigator · engineer
accountant · cashier
groundskeeper
pipefitters · mechanics

20. 1. Agriculture
2. Military
3. d.
4. less than 10%

21. 1. 13,200 gallons per month.

22. dishwasher
automobile
rice cooker
coffee maker
wash machine
steam iron
water bed
fire hydrant
toilet
shower
sprinkler

24. conserve water

25. water is precious

29. fire hydrant

32. clean up waste water
desalinate ocean water
do not waste water